

Claim Amendments

Claims 1-189 (Cancelled)

190. (New) A method for producing a micro, submicro and/or nanostructure for modulating light, comprising the steps of:

providing a theoretical simulation of light modulating parameters for the structure, the simulation being based on an exact numerical calculation of fields within the structure and outside a light emitting surface of the structure;

characterizing the emitting surface of the structure by geometric and light profiling at the surface, in the near-field of the surface, and at far-field distances from the surface; and

predicting and fabricating the emitting surface integrally with said simulation and characterization steps.

191. (New) The method of claim 190, wherein fabricating said structure includes forming an emitting surface on the end of an optical fiber, hollow fiber, or other waveguide.

192. (New) The method of claim 190, wherein providing a simulation includes analyzing coupling efficiency, beam waist diameter and working distance taper angle for light emitted from said structure, and determining radius of curvature for

said emitting surface for designing an optimal structure.

193. (New) The method of claim 190, wherein providing a theoretical simulation includes finite element field calculations and/or exact calculations with or without interactively defined boundary conditions, and wherein characterizing the emitting surface includes monitoring the fabrication of the nanostructure using near-field and far-field optical characterization with scanned probe imaging.

194. (New) A method of characterizing a micro, submicro and/or nanostructure in which having a waveguide and/or emitting surface including determining the phase properties of light within the structure or of light emitted from the emitting surface wherein such phase properties are assessed by far-field or near-field techniques including scanned probe microscopic techniques integrated with standard far-field techniques or used without such techniques to determine the phase properties of the structure with or without on-line irradiation or local heat.

195. (New) The method of claim 194, wherein characterizing the emitting surface further includes measuring light emitted from the surface for return loss,

196. (New) The method of claim 190, wherein the step of fabricating includes pulling an optical fiber to produce an axial protrusion at the end of the fiber, and controlling the shape of the protrusion by iterative characterization of the protrusion and comparison with the theoretical simulation of the protrusion

structure to form a lens.

197. (New) The method of claim 196, wherein the fiber is fabricated to direct light exiting the fiber at an angle relative to the direction of the fiber axis.

198. (New) The method of claim 196, wherein fabricating includes forming a cylindrical or elliptical lens.

199. (New) The method of claim 196, further including stripping the fiber and thereafter selectively coating the fiber and/or lens.

200. (New) The method of claim 199, wherein coating includes deposition of metal on said fiber and said lens, and further including forming an aperture in the metal coating on said lens.

201. (New) The method of claim 200, wherein forming an aperture includes nanoindentation, ion beam etching, chemical etching, or femtosecond laser nonlinear ablation, or a combination thereof.

202. (New) A method for fabricating a micro, submicro and/or nanostructure for modulating light, comprising the steps of:

forming a waveguide incorporating an emitting surface, and
forming on said emitting surface Fresnel and/or diffractive optics and/or a

Bragg grating.

203. (New) The method of claim 190, wherein the step of fabricating includes forming a waveguide having a core and having an emitting surface, and further including forming a diffraction pattern on the core to alter the index of refraction or topography of the core to focus emitted light, to compensate for light dispersion, to produce phase front correction in emitted light, to remove or impose birefringence, or to remove lens aberrations.

204. (New) The method of claim 203, wherein forming a diffraction pattern includes:

coating an end of said waveguide core with metal and dielectric layers;
forming an aperture in said layers;
directing light through said aperture; and
manipulating the light, the thickness and number of metal and dielectric layers being matched to the wavelength of light to be manipulated.

205. (New) The method of claim 190, wherein the step of fabricating includes forming a solid immersion lens on a high index optical fiber.

206. The method of claim 205, wherein the step of forming a solid immersion lens includes:

forming a ball on the end of a cylindrical or other structure; and

polishing the ball to produce a flat head that serves as the lens, wherein the cylindrical or other structure could be used as a force sensing device to control the position of the solid immersion lens .

207. The method of claim 206, wherein forming said lens further includes providing diffractive optics on the lens.

208. (New) A method of characterizing optical and other surfaces in a sample imaging system in which nanometric blocking or shadowing is used together with differences in intensity when the nanometric blocking probe either blocks or does not block rays of a far-field imaging system from the position on the sample to improve resolution.

209. (New) A method for light control at the tip of a cylindrical or other structure, comprising:

forming a tapered hollow micropipette;

introducing a solution into the micropipette;

forming a metal nanoseed in said solution; and

growing the seed to produce a nanoparticle in the micropipette for controlling light passing through the micropipette.

210. (New) The method of claim 209, wherein forming a nanoseed includes inserting an end of the micropipette into a liquid for initiating seed formation.

211. (New) The method of claim 210, further including pulling the micropipette out of the liquid at a rate controlled to produce a selected nanoparticle geometry at the end of the micropipette.

212. (New) A method for forming an optical or mechanical structure, comprising:

dipping a tip of the structure in a fluid medium; and
retracting the structure with nanometric control from the medium to form an optical or mechanical structure.

213. (New) A method for forming an optical or mechanical structure, comprising:

filling a micropipette with a material having a selected index of refraction;
causing a portion of said material to exit at the tip of the micropipette to produce a protrusion; and
shaping the protrusion to form an optical element or mechanical element.

214. (New) A method for fabricating a lens, comprising:

shaping a mold for use in forming a lens;
simulating the shape of the mold to define the structure, refractive index, and light modulating properties of the lens to be formed in the mold;
characterizing the shape of the mold by geometric and light profiling of the mold surface in the near field and the far field; and

iteratively shaping the mold while simulating and characterizing its shape.

215. (New) The method of claim 214, further including forming multiple molds for use in fabricating a micro lens array.

216. (New) A method for producing an optical waveguide, comprising:

simulating the parameters of the waveguide on the basis of a calculation of fields within the waveguide structure and outside a light emitting lens on the waveguide;

characterizing parameters of the lens by near-field and far-field geometric and light profiling of the lens; and

iteratively fabricating the waveguide and lens integrally with said simulating and characterizing the lens parameters.

217. (New) The method of claim 216, further including:

integrating said near-field and far-field characterizing steps for testing waveguides and lenses and thus aiding in the mounting and integration of these devices with on-line motion and characterization.

218. (New) A method of fabricating a multimode optical fiber transmitter or coupler to a single mode structure, including:

forming a tapered fiber and lens having a taper angle and radius of curvature, respectively, to provide a lens focus with high accuracy from the lens surface and having a waist diameter of about 3.8 microns.

219. (New) A method in which extremely small spot size integral optical fiber lens are used to make a diffraction limited spot size and in which these devices can be cantilevered so that they could fit under the lens of a microscope or can be used as a straight lensed fiber so that a simple scanning integral lensed fiber based confocal (SILC) microscope can be built with the same piezo technology that is used for atomic force microscopes in order to replace complicated beam scanning confocal microscopes with much higher throughput, collection efficiency and resolution than conventional confocal beam scanners.

220. (New) A method as in claim 219 in which a simple scanning integral lensed fiber based confocal (SILC) microscope can be built with the same piezo technology that is used for atomic force microscopes in order to replace complicated beam scanning confocal microscopes with much higher throughput, collection efficiency and resolution than conventional confocal beam scanners.

221. (New) A method for producing a confocal microscope in which an optical fiber is placed in the scanner of an atomic force microscope at the eyepiece or some other port of the microscope and is used as the lens of the microscope for final focusing and collection.

222. (New) A method as in claim 221, in which a fiber bundle is used.